Can the concept of firm flexibility explain small farms‘ economic strength and survival? Empirical evidence from selected EU countries

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Outline

- Study background and objective
- Firm flexibility concept
- Data and Methodology
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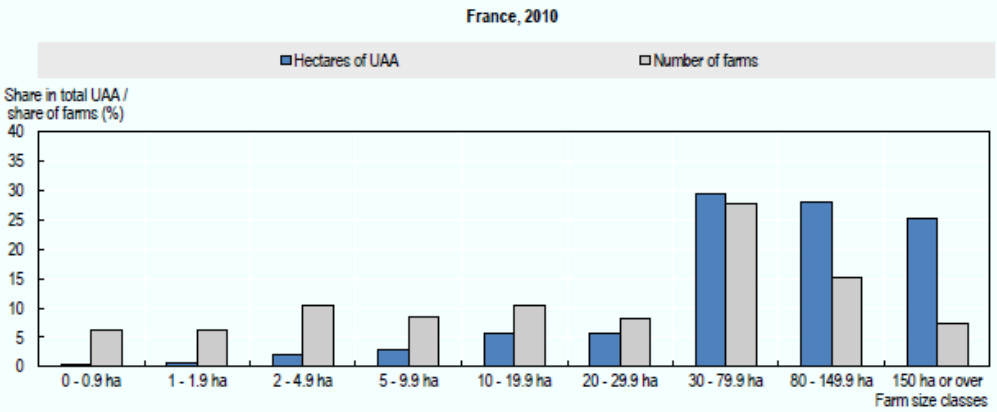
Study background

- Results of a recent OECD cross country comparison of farm size distribution indicate the persistence of small scale farms.
- Need to better understand the determinants of structural adjustments in agriculture.
- Flexibility could be an economic factor explaining the survival of small family farms.

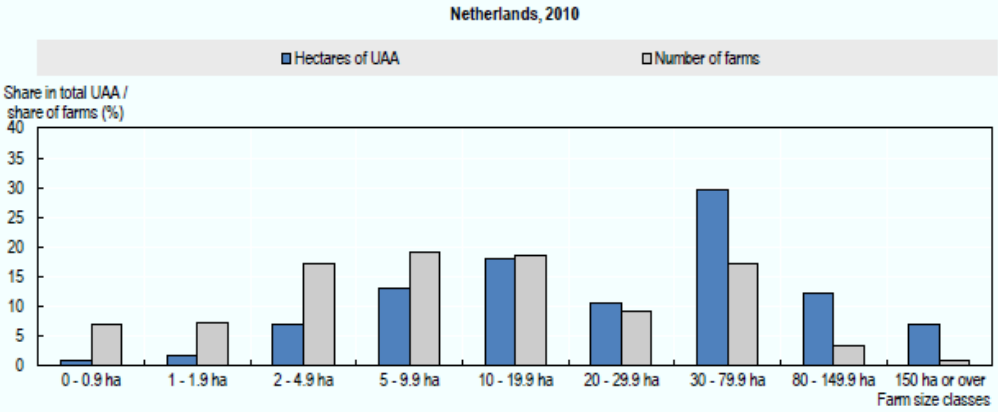
Study background

Distribution of land and farms by farm size: France and the Netherlands, 2010



Note: UAA: Utilized Agricultural Area.

Source: Eurostat (based on 2010 full-scope Farm Structure Survey), 2011.



Note: UAA: Utilized Agricultural Area.

Source: Eurostat (based on 2010 full-scope Farm Structure Survey), 2011.

Bokusheva and Kimura (2016)

Study objectives

- to measure farm flexibility
- to examine the relationship between farm flexibility and farm productivity
- to evaluate determinants of farm flexibility

Firm flexibility concept

- Stigler (1939) defines flexibility in terms of firms' cost curves: the flatter the curvature of the average total cost curve, the greater the firm's flexibility.
  - the ability of a single-product firm to adjust output to exogenous shocks with relatively low costs
- Chambers (1988) defined cost flexibility as a ratio of marginal and average costs.
- Suarez et al. (1991), Carlsson (1989) and recently Cremieux et al. (2005) and Renner, Glauben and Hockmann (2014) added a multi-dimensional concept of flexibility.
  - the flexibility is determined not only by the ability to adjust output but also the structure of the production portfolio to exogenous shocks with relatively low costs.

Farm flexibility

- Farm flexibility was investigated by
  - Weiss, 2001: ca 40,000 farms in Upper Austria (1980, 1985, 1990 agricultural census data)
  - Renner et al., 2014: ca 34,000 Polish farms (2004-2007 FADN data).
- Both studies found a negative relationship between farm size and flexibility.

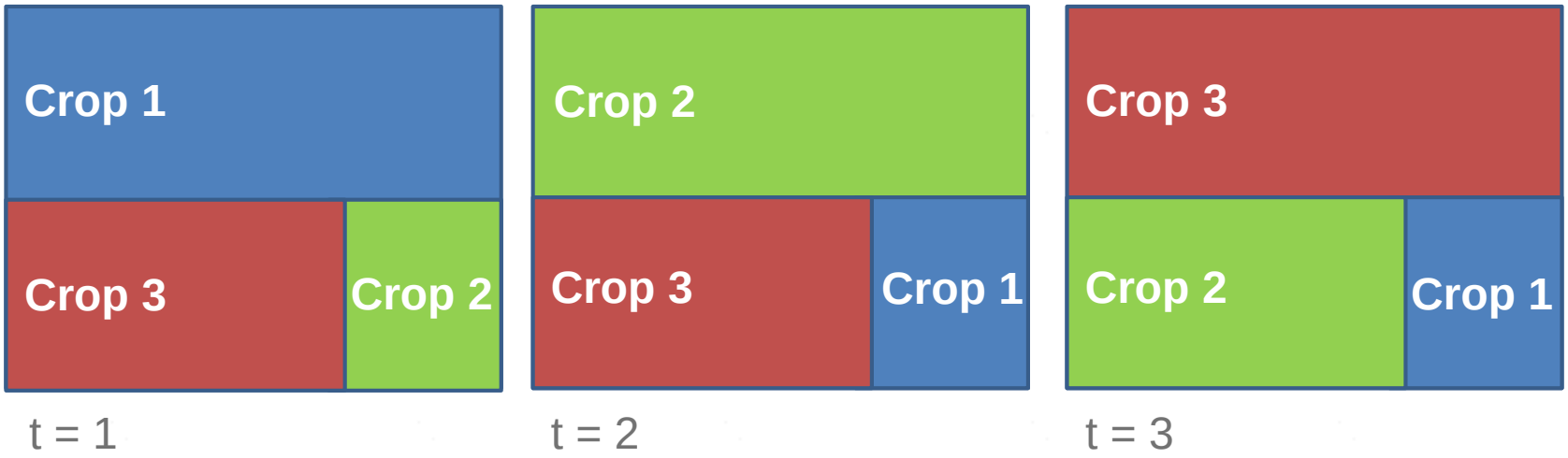
Economies of scope

- Renner et al. (2014) showed that economies of scope are an important source of farm flexibility
- Small farms might lack economies of scale but compensate them by economies of scope, at least partially
- Features of technology are of relevance: Access to flexible technologies might help farmers to cope with demand fluctuations and increase their competitiveness

Flexibility vs Diversification

Comparison to Herfindhal index (HI)

$$HI^{-1} = \frac{1}{\sum_{j=1}^{J} s_j^2}$$



Data

- EC FADN data on cereals, field crops, mixed crops, and mixed crops and livestock farms for 2004-2013
- Country samples:
  - Czech Republic (3090)
  - France (6933)
  - Germany (6752 – West; 4764 - East)
  - Hungary (4084)
  - Poland (8339)
  - UK (England) (2118)

Data: Farm outputs and inputs

Variable	Description
Cereals	Cereals output
Other crop output	Total crop output except cereals
Other farm output	Livestock output and other farm output
Materials	Sum of total specific costs and total farming overheads
Land	Utilised Agricultural Area, UAA
Labour	Total labour input
Capital	Sum of depreciation of fixed assets and contract work costs

Methodology

- A flexible representation of production technology using a Translog input distance function
- Use of Generalized Method of Moments (GMM) to obtain consistent parameter estimates

Methodology

- Cremieux et al. (2005) developed a measure of a **multi-output firm flexibility**, which can be calculated using a flexible cost function. This measure consists of three terms corresponding with the effects of scope, convexity and scale.
- The first term refers to cost saving which can be achieved in the presence of **economies of scope**.
- The second is related to the curvature of the cost function: The flatter the curvature of the average cost function, the lower the **convexity effect**, indicating the ability to adjust levels of production to changes in demand at relatively low costs.
- The third term captures the effect of **economies of scale**.

Methodology

- While **small-scale** firms may be more flexible due to the **convexity** effect and the effect of **economies of scope**, **larger farms** may show higher flexibility due to **scale efficiency**.
- Hayargasht et al. (2008) showed how economies of scope can be derived using a flexible form of an input distance function.
- Renner et al. (2014) derived a primal measure of flexibility for a multi-output production technology and proposed to decompose the cost flexibility measure by Cremieux et al. (2005) into three components– convexity effect, scope effect and scale effect.

Results

Shadow output and input shares: Country samples' average estimates

Output/Input	France	West Germany	United Kingdom
	2004-2013	2004-2013	1995-2004
Cereals	0.43 (0.54)	0.29 (0.40)	0.45 (0.54)
Other crops	0.17 (0.21)	0.22 (0.31)	0.21 (0.26)
Other output	0.19 (0.25)	0.21 (0.29)	0.17 (0.20)
Materials	0.51	0.51	0.57
Land	0.13	0.13	0.17
Labour	0.20	0.25	0.16
Capital	0.16	0.10	0.10
Economies of scale	1.27	1.39	1.21

Results

Shadow output and input shares: Country samples' average estimates

East Germany, Czech Republic, Hungary and Poland, 2004-13

Output/Input	East Germany	Czech Republic	Hungary	Poland
Cereals	0.35 (0.41)	0.36 (0.38)	0.44 (0.49)	0.33 (0.49)
Other crops	0.26 (0.30)	0.31 (0.33)	0.26 (0.30)	0.17 (0.25)
Other output	0.26 (0.30)	0.28 (0.29)	0.20 (0.22)	0.18 (0.26)
Materials	0.65	0.72	0.56	0.50
Land	0.07	0.07	0.15	0.09
Labour	0.12	0.13	0.12	0.31
Capital	0.16	0.07	0.18	0.10
Economies of scale	1.16	1.04	1.11	1.47

Results

Estimates of flexibility and its components

	Flexibility		Economies of scope effect		Scale effect		Convexity effect	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
France (N = 3 762)	0.082	0.284	0.160	0.209	0.342	0.233	-0.419	0.273
West Germany (N = 3 978)	0.351	0.065	0.111	0.081	0.566	0.079	-0.326	0.095
East Germany (N = 882)	0.405	0.169	0.336	0.045	0.334	0.124	-0.264	0.084
England (N = 1 279)	0.299	0.070	0.060	0.078	0.360	0.101	-0.122	0.094
Czech Republic (N = 575)	0.044	0.045	0.350	0.122	0.043	0.074	-0.349	0.112
Hungary (N = 2 461)	0.169	0.074	0.505	1.592	0.242	0.113	-0.579	1.604
Poland (N = 5 711)	0.577	0.167	0.218	0.085	0.666	0.203	-0.306	0.050

1. Since flexibility refers to marginal increases in average cost per unit of output, the lower the value of the flexibility index and its components the higher is the flexibility. Flexibility and its components were estimated only for the sample farms, for which theoretically consistent results were obtained with respect to all inputs and outputs.

Summary of results

- **Flexibility** was estimated to be statistically **significant** for five study samples as evaluated at respective country sample averages – the both parts of **Germany, England, the Czech Republic and Poland**.
- Among these five countries, **Czech farms** were estimated to use **most flexible technologies**. **English** sample farms also were found to show relatively **high flexibility**.
- The **economies of scope** effect was estimated to be **positive** for all farm samples implying that technologies used currently by crop farms **do not show complementarities** in the production of the three analysed farm outputs.

Summary of results

- Significant estimates of **diseconomies of scope** were obtained for **West and East German, Czech, and Polish** sample farms. Diseconomies of scope were measured to be of the lowest magnitude for West German farms as evaluated at the sample averages.
- Diseconomies of scope were found to be large for Czech and East German sample farms.
- **The scale effect** was computed to be the **lowest** at the sample average for **Czech sample farms**, although not significant, and Hungarian sample farms.
- Among the country samples with significant estimates, on average **highest** estimates of the **convexity effect** were obtained for the **Czech and West German** samples suggesting **smoothest adjustments in farm size** for these two country samples.

Summary of results *cont.*

- The results of the analysis performed to explain variation in **farm flexibility** show that
  - **Large crop farms in East Germany, England, Hungary and Poland** show **higher flexibility**. This result suggests that highly specialized large-scale operations appear to have cost advantages compared to more diversified production systems in these countries.
  - For **West Germany** a **negative and significant relationship between farm flexibility** and farm size was estimated implying that West German farms may exploit other sources of cost flexibility. Compared to other study samples, they show relatively low diseconomies of scope and a flatter curvature of the average cost function.
  - West German farms with **higher flexibility are more diversified**, rely stronger on contract work and paid labour, have significantly higher crop area shares of proteins and energy crops, but also use more **intensive production practices** (use more fertilizer and plant protection)
  - **Higher flexibility** is found to **correlate** significantly with the following characteristics of **East German** farms – **higher share of paid labour and contract work, stronger diversification** towards activities beyond crop production, **lower intensity of chemical fertilizer** and plant protection use.

Summary of results *cont.*

- **English** sample farms estimated to have higher flexibility use significantly less contract work than those found to show lower flexibility. **Flexible farms** in the English sample **appear to have significantly higher paid labour and rented land shares**, relatively low magnitudes of diversification in crop production but higher shares of livestock output.
- Similar to West German sample farms, they also tend to use **more mineral fertilizer and plant protection materials**.
- Hungarian farms can significantly improve their flexibility by involving stronger in crop production diversification and production of farm outputs beyond those from crop and livestock production. Similar to English farms they have higher shares of paid labour and lower shares of contract work costs in total costs. Similar to East German farms with higher flexibility, they tend to have relatively low shares of fertilizer and plant protection costs in total cost.
- **Polish sample farms** assessed to be more flexible show analogue to English sample farms significantly **higher shares of paid labour and rented land, higher extent of specialisation** within crop production and higher shares of livestock output. They also have lower shares of contract work costs in total costs.
- Similar to West German farms which also have relatively small farm structures, Polish farms appear to increase their flexibility through **more intensive use of fertilizer and herbicides**.

Summary of results *cont.*

- **Decoupled payments** were found to encourage **East German** farms to **improve flexibility**. For the four other country samples with significant flexibility estimates, the effect of subsidies was not found to be significant.
- A significant negative rank correlation was measured to be present between **TFP growth and flexibility** values for **East German, English, Hungarian and Polish** sample farms implying a **positive relationship** between these two indicators for these four country samples.
- No significant correlation was found between farm flexibility and TFP growth for West German sample farms.

Summary of results *cont.*

- The results of the regression analysis on **determinants of economies of scope** suggest:
  - **German farms** with **lower diseconomies of scope** have **higher shares of rented land**. They also tend to show a larger extent of diversification in crop production and higher shares of energy crops in arable land. Farms situated in **less favoured areas** also show **lower diseconomies of scope** obviously because they cannot be as cost efficient due to intensification as their counterparts located in more productive regions.
  - The estimation results for the Polish farm sample indicate that there is a significant potential to reduce costs in integrated production systems by getting access to specific technologies through contract work provided by farms specialised in relevant activities.
  - For all three country samples with significant estimates of the economies of scope effect, the intensity of chemical fertilizer use and plant protection was found to significantly increase diseconomies of scope. Those results suggest that technologies currently used on farms appear to favour a stronger specialisation and intensification of production.

Conclusions

- **Farm flexibility** was revealed to be determined mainly by the **scale and convexity effects** enabling cost efficient adjustments in the size of farm operations.
- **Large farms** appear to be in a better position to **exploit economies of scale and to invest in productivity** enhancing technologies than small-scale farms.
- **No significant economies of scope** were found in the analysed crop production systems. This implies the **absence of significant cost complementarities** between three analysed groups of outputs – cereals, other crops and other farm output in the study countries.
- The **only exception** was the **English farm** sample, for which a significant weak complementarity between cereals and other crops was measured.
- For two countries, **Germany and Poland**, significant **diseconomies of scope** were estimated.

Conclusions cont.

- However, **economies of scope can be present at lower levels of output aggregation** and in regional production systems.
- More systematic research is required to understand the potential for improving local eco-system resilience and productivity by engaging in more integrated production systems.
- The effect of policy instruments such as **environmental cross-compliance** also should be evaluated as it affects farm production decisions and technology.

Thank you for your attention!